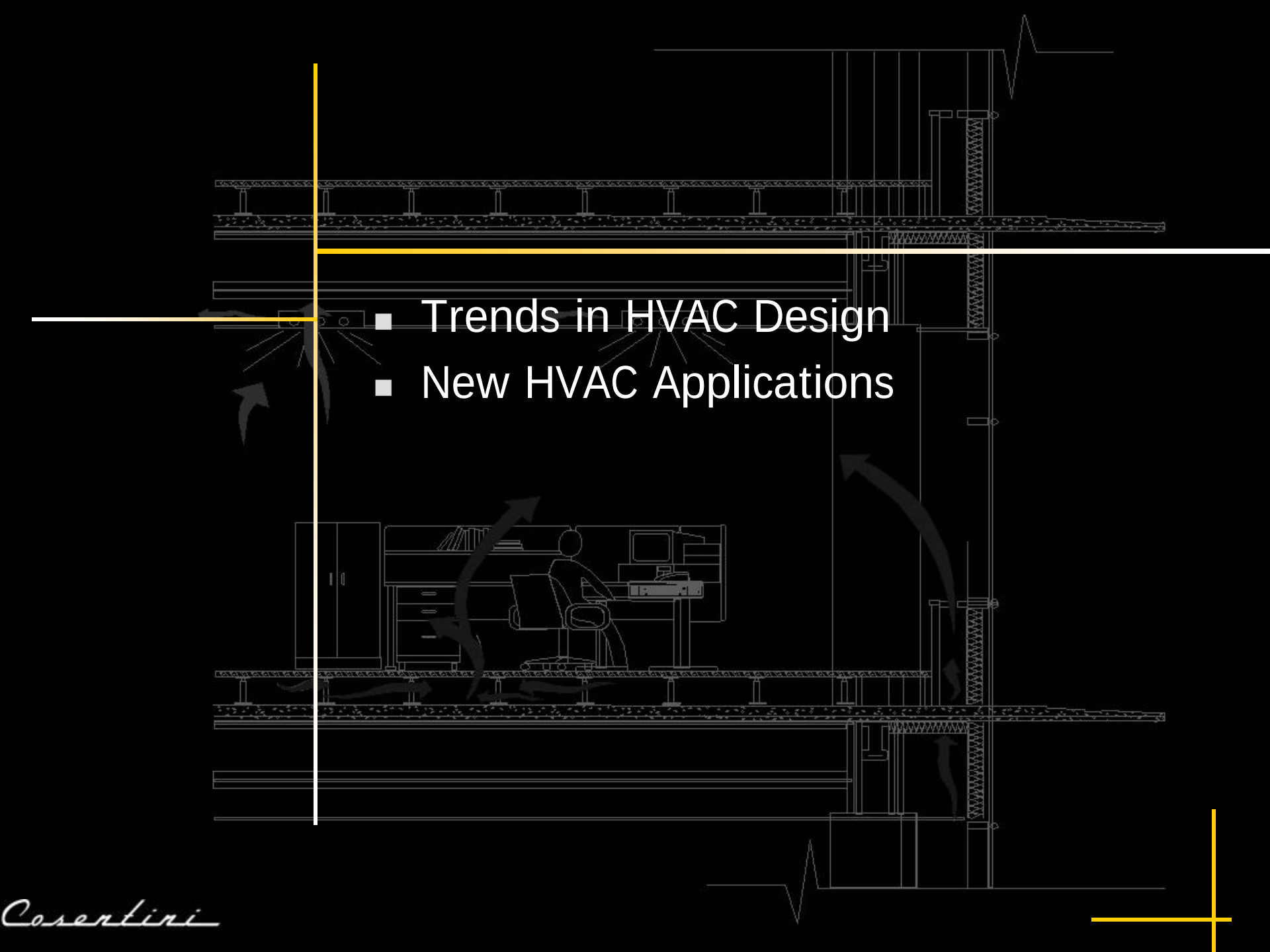
Energy 2001
Walking on Air – Energy Efficient, Flexible and Adaptive HVAC Distribution Systems



- Trends in HVAC Design
- New HVAC Applications

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Changes in HVAC Design Criteria

- Cooling Capacity – 5-6 Watts/sq ft
  - Increased Loads
  - Higher Population Density
  - More Equipment
- Overtime Air Conditioning
  - Reduced Overtime Cooling Cost
  - More Overtime Cooling Needs
  - Flex Hours
- Supplementary and 24 Hour Cooling
  - Special Cooling Needs for Technology Rooms, Conference Rooms, High Load Areas

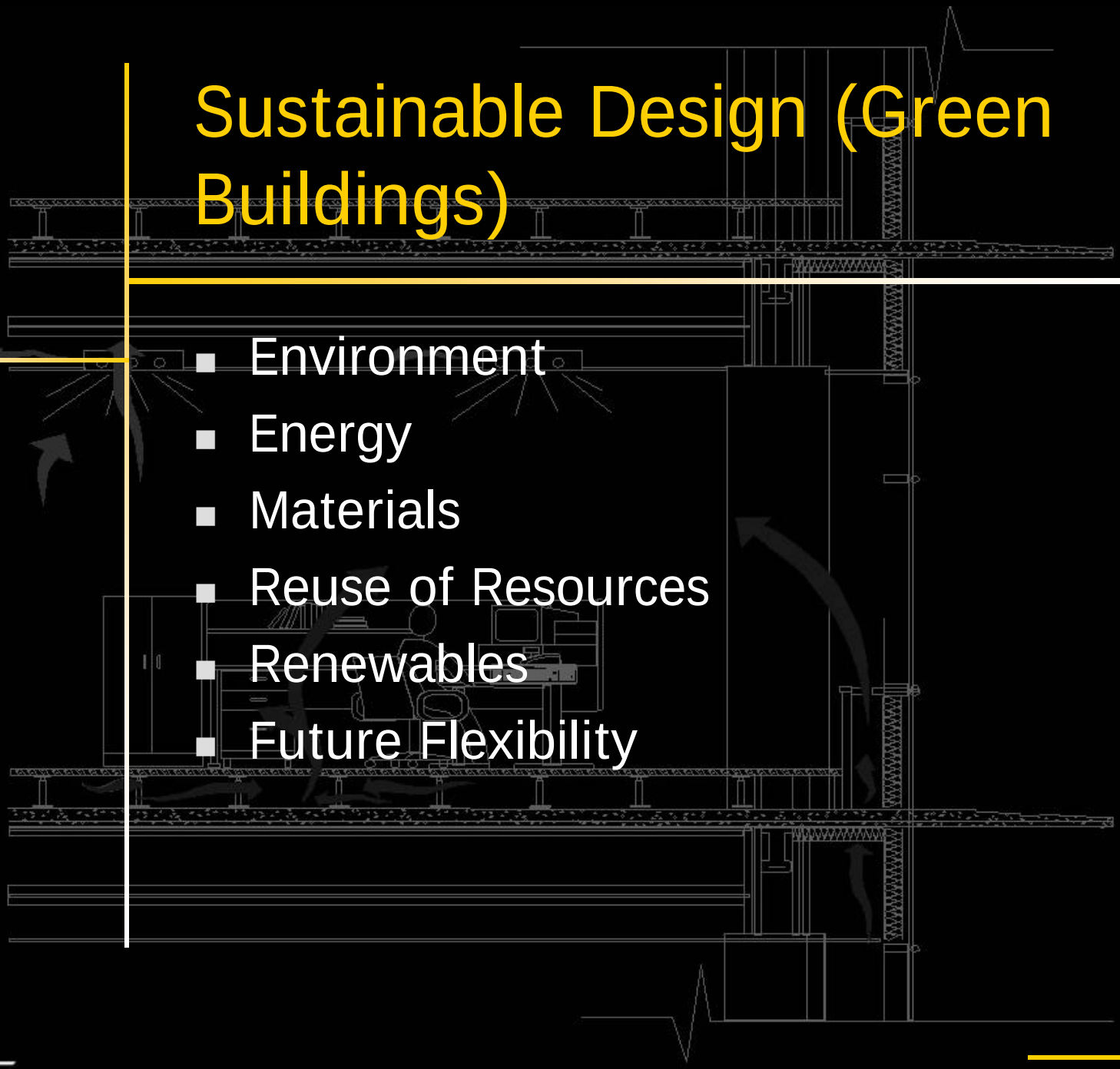
Human Factor

- More Fresh Air
  - Recognition of Greener Buildings (LEED)
  - Accommodate Excess Air for Conference/Assembly Areas
  - Accommodate Outside Air During Overtime Hours
- Task Cooling
  - Control One's Own Environment

Recognition of Changes in Technology/Flexibility

- Changes in Technology = Changes in Load Distribution
- Development of Pathways to Deal with Load Migration
- Modifications to Physical Work Environment
- Fast, Low Cost Changes

Sustainable Design (Green Buildings)



- Environment
- Energy
- Materials
- Reuse of Resources
- Renewables
- Future Flexibility

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LEED Building Rating Scale

Category	Maximum Points
Sustainable Sites	14
Water Efficiency	5
Energy & Atmosphere	17
Materials & Resources	13
Indoor Environmental Quality	15
Total Core LEED Rating System Points	64
Innovation and Process Points	5
Total Points Possible	69

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Innovative Strategies for Sustainable Design

- Fuel Cells
- Dynamic Exterior Wall Systems
- Passive Single Wall Systems
- Underfloor Air Distribution System
- Natural Ventilation
- Wind Power
- Solar Power
- Geothermal
- Peak Shaving (Plant Efficiency)
- Cogeneration
- Office Equipment Power Conservation
- Photovoltaic
- Hybrid Systems

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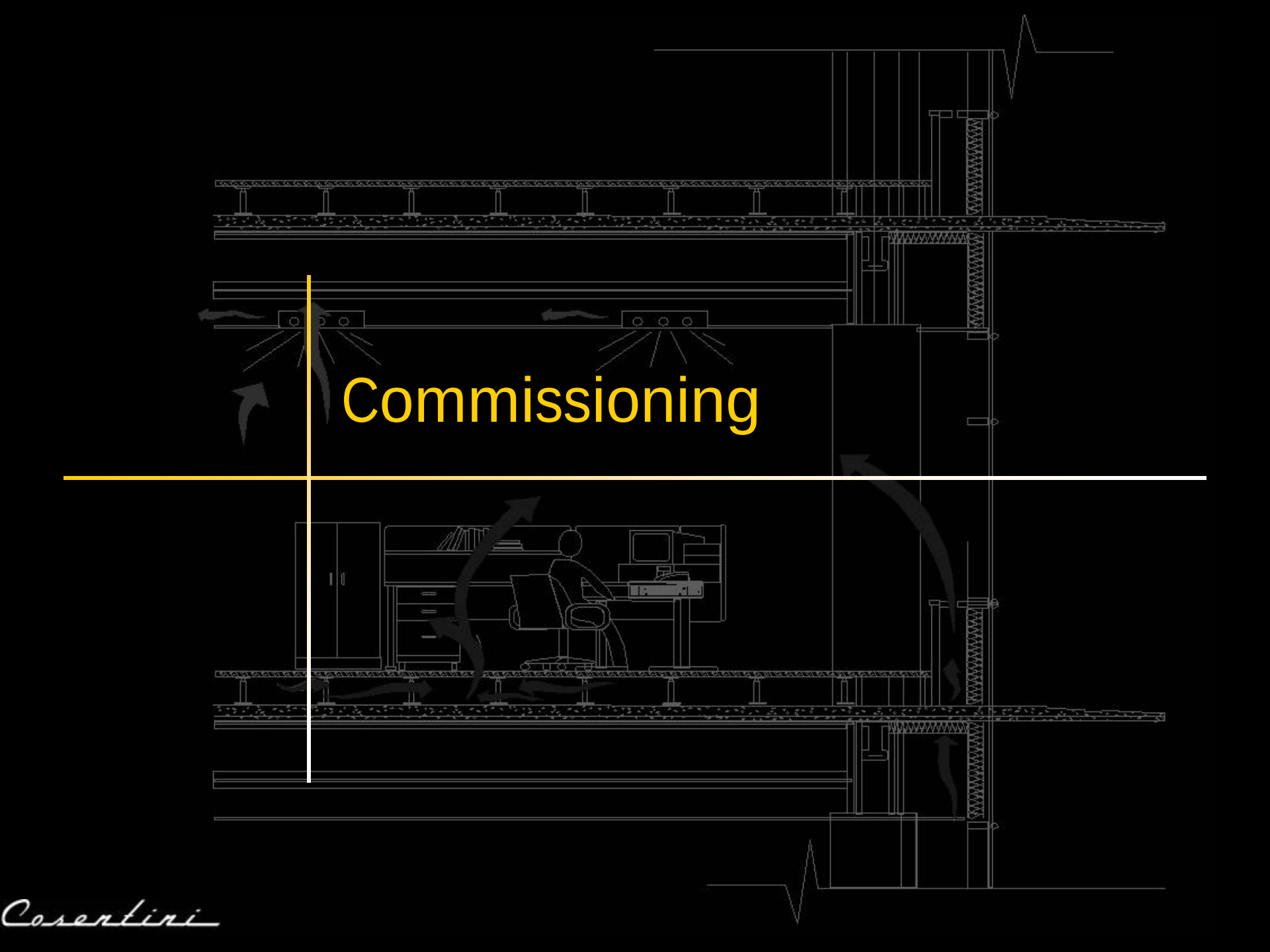

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Commissioning Goals

- Communication Between Designer & Operator
- To deliver a fully functional and verified HVAC system that complies with the design intent.
- To provide adequate training to building personnel that will allow them to properly maintain and operate these systems.
- To turn over proper documentation showing how the system was designed, installed and intended to operate.

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Benefits

- Training and improved operator knowledge System performance
- Reduced downtime
- Improved IAQ and comfort conditions for occupants
- Reduced number of deficiencies during construction
- Properly documented and catalogued records, as-built drawings and O&M manuals.
- Assures Operating Cost Savings

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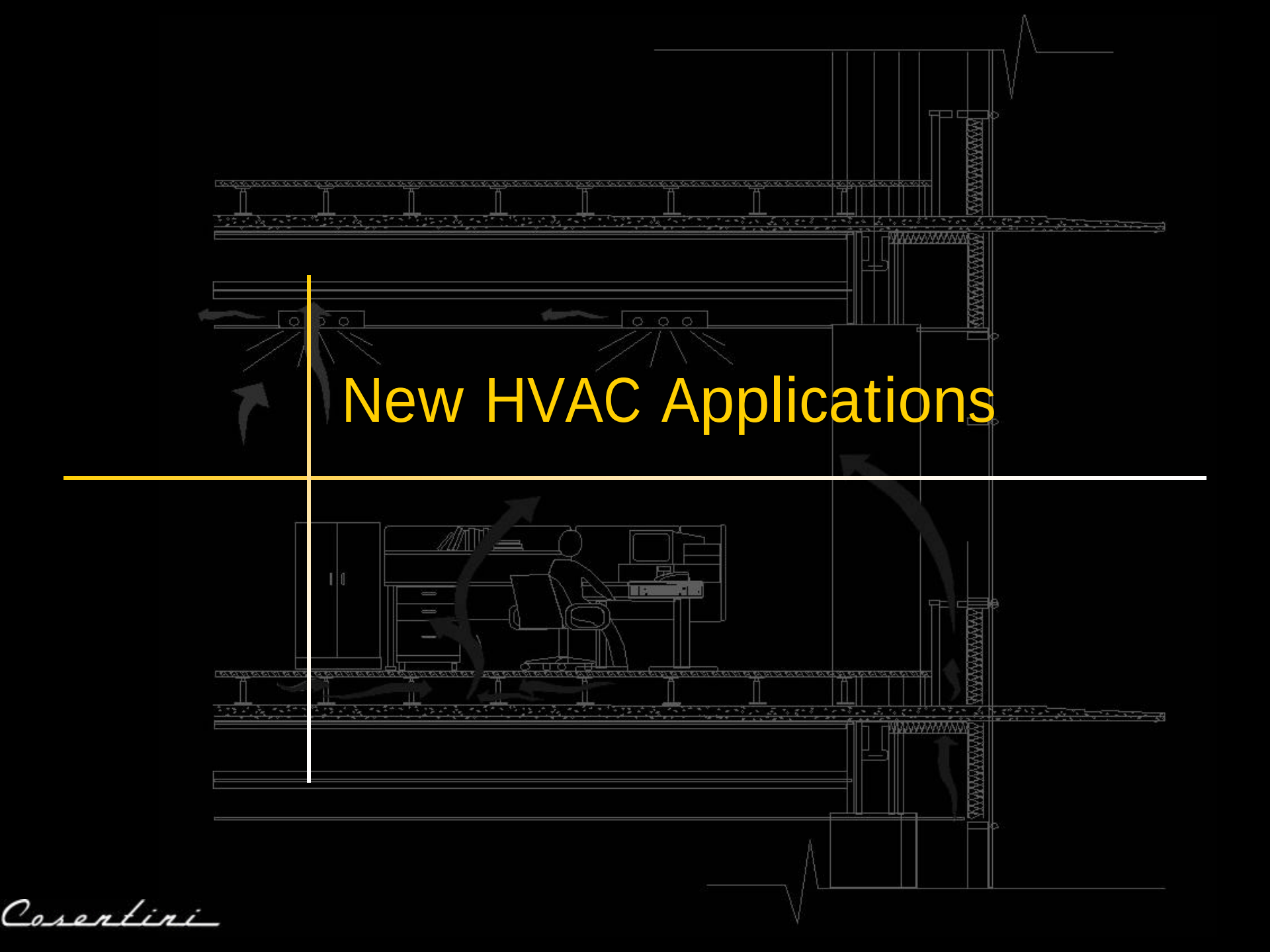
New HVAC Applications
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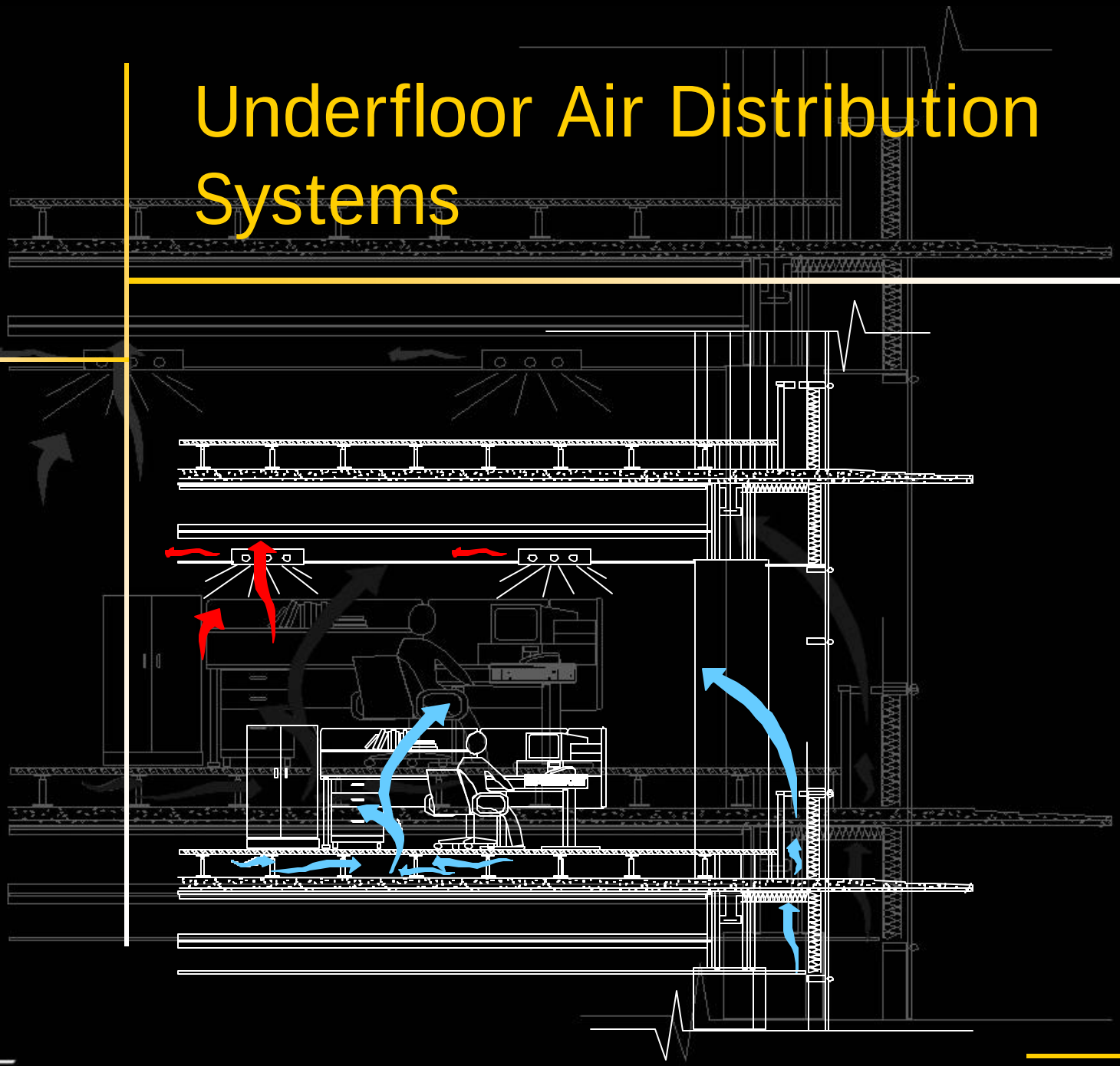
Underfloor Air Distribution Systems



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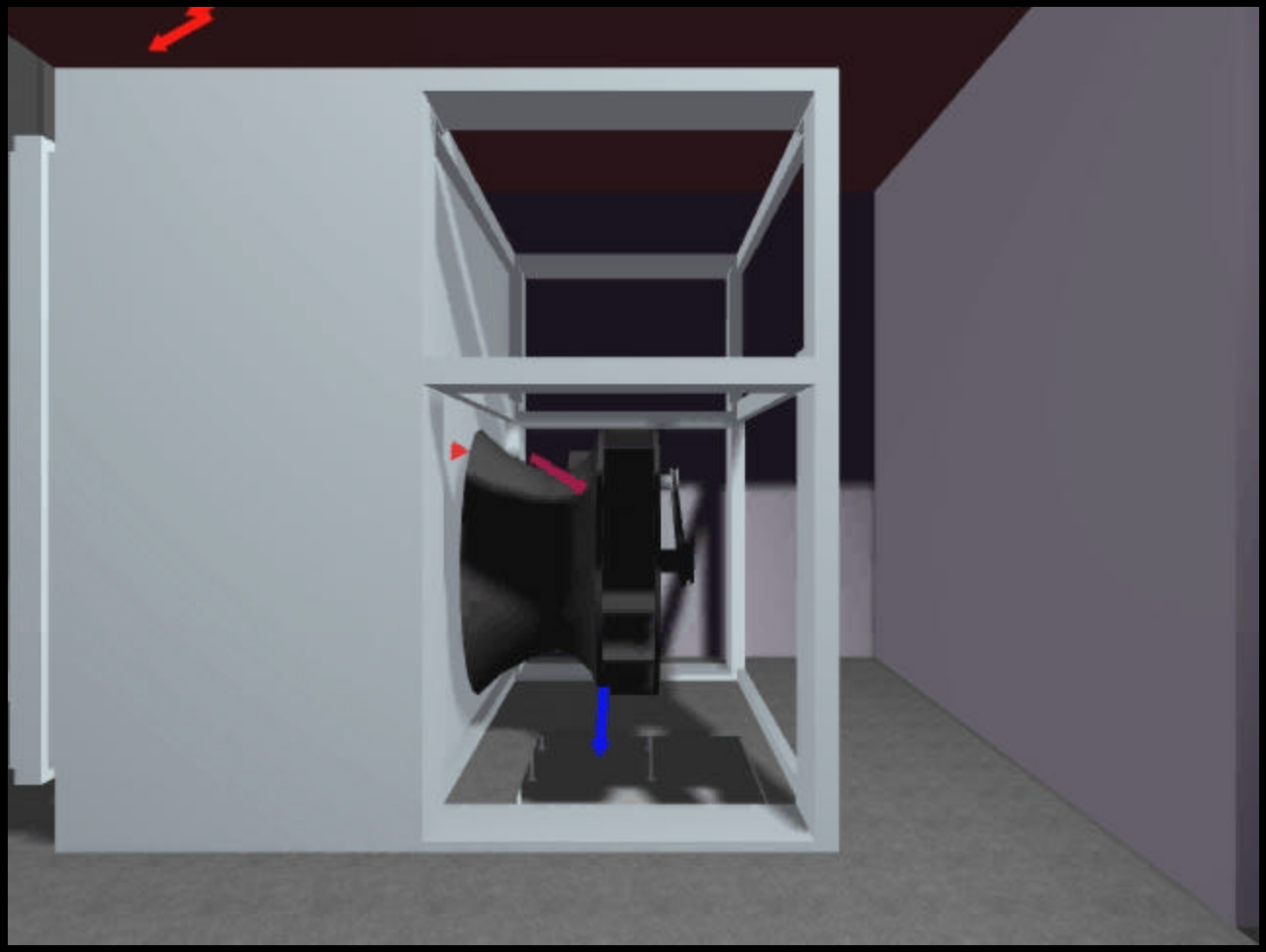

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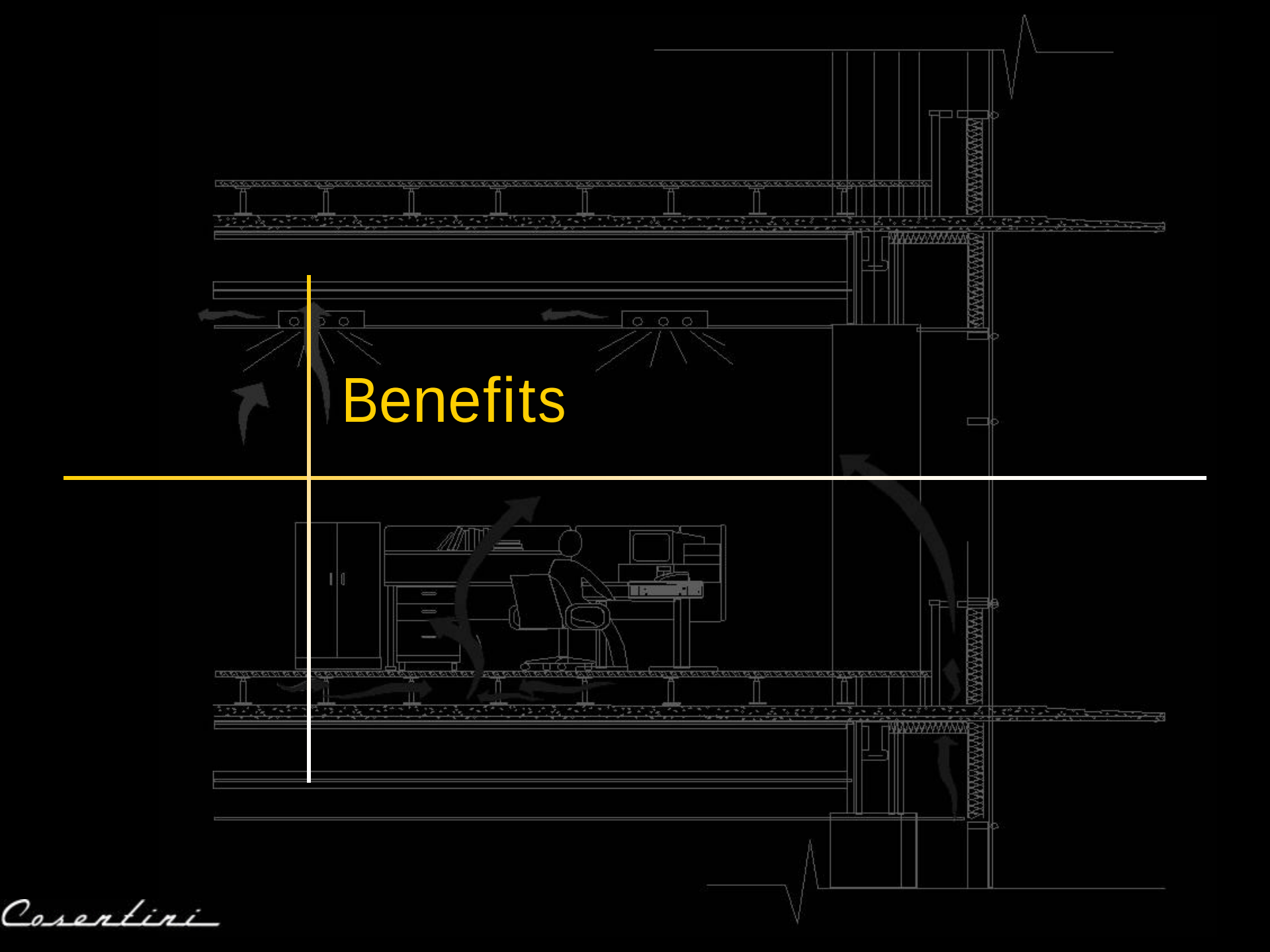

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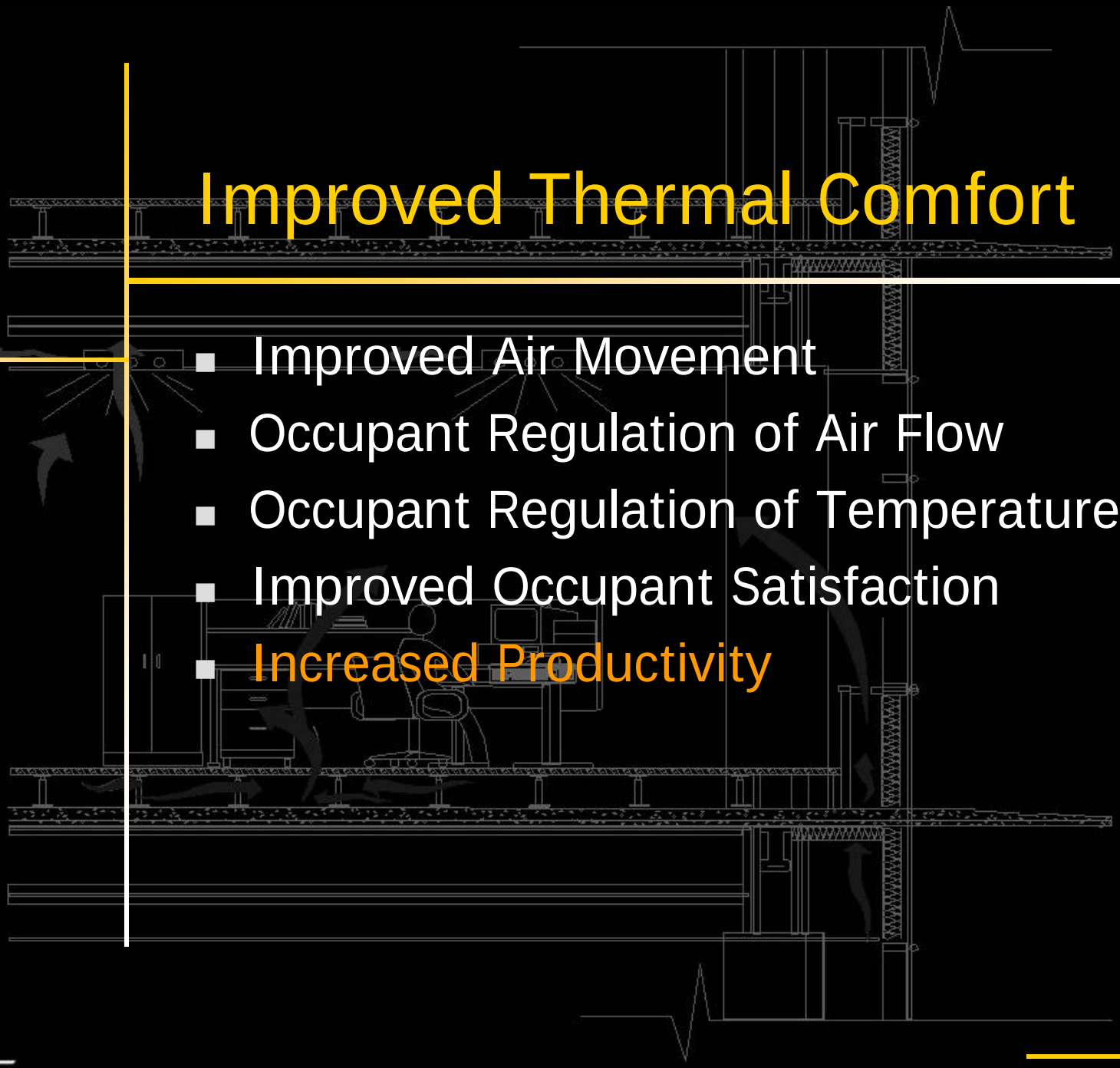
Improved Thermal Comfort



- Improved Air Movement
- Occupant Regulation of Air Flow
- Occupant Regulation of Temperature
- Improved Occupant Satisfaction
- Increased Productivity

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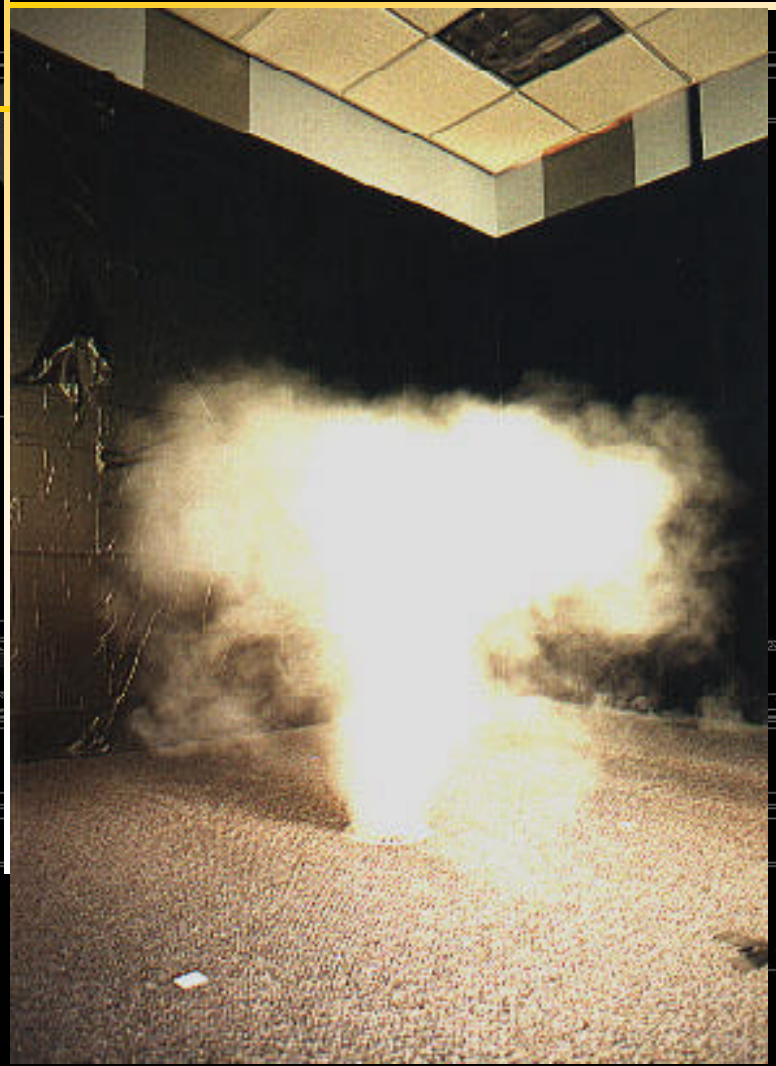

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Indoor Air Quality

- Increased Ventilation Effectiveness (Fresh Air)
- Cleaner Environment
- Easy Access for Maintenance of Air Stream
- Additional Air-Side Free Cooling Hours

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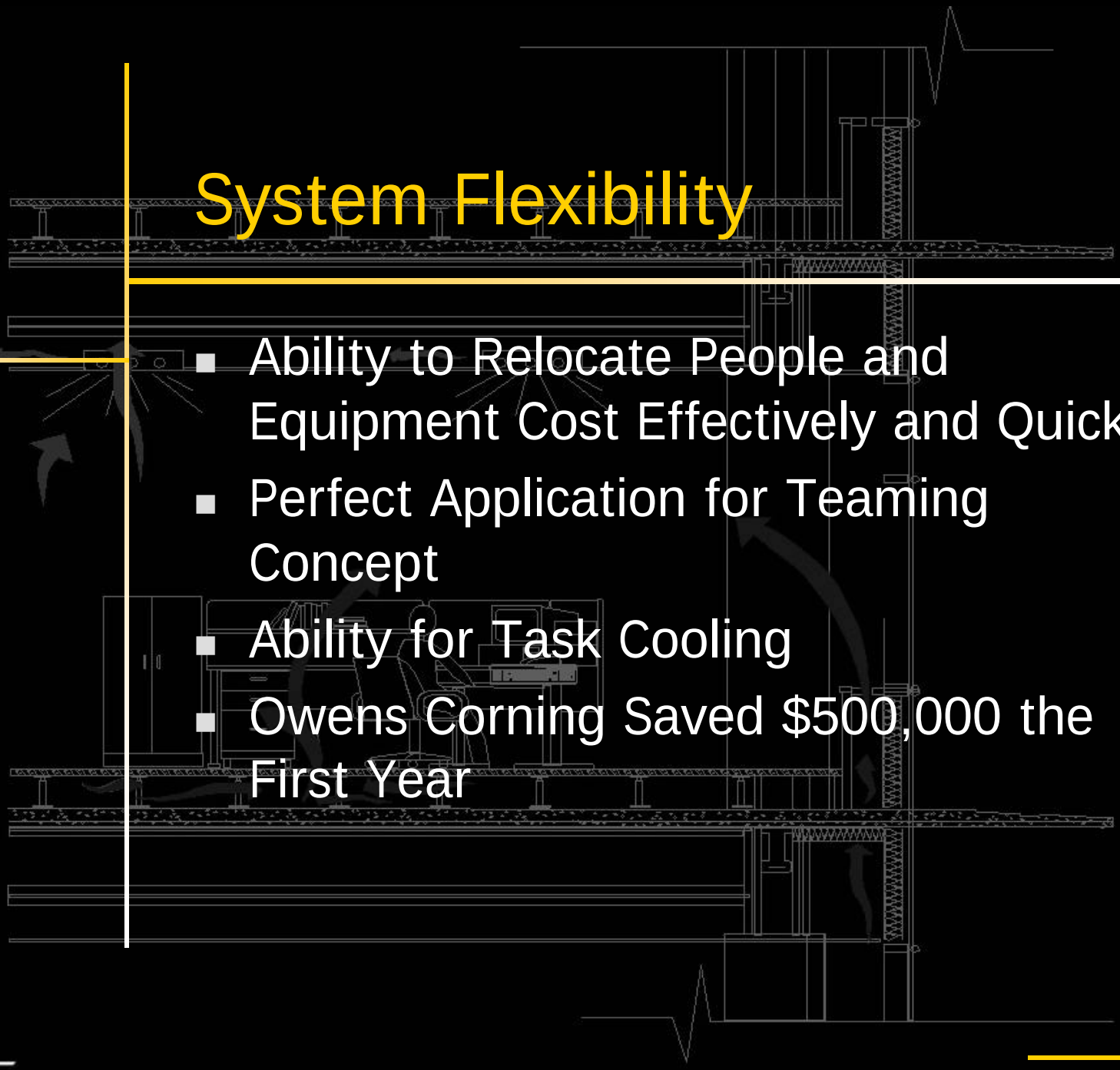
System Flexibility

- Ability to Relocate People and Equipment Cost Effectively and Quickly
- Perfect Application for Teaming Concept
- Ability for Task Cooling
- Owens Corning Saved $500,000 the First Year



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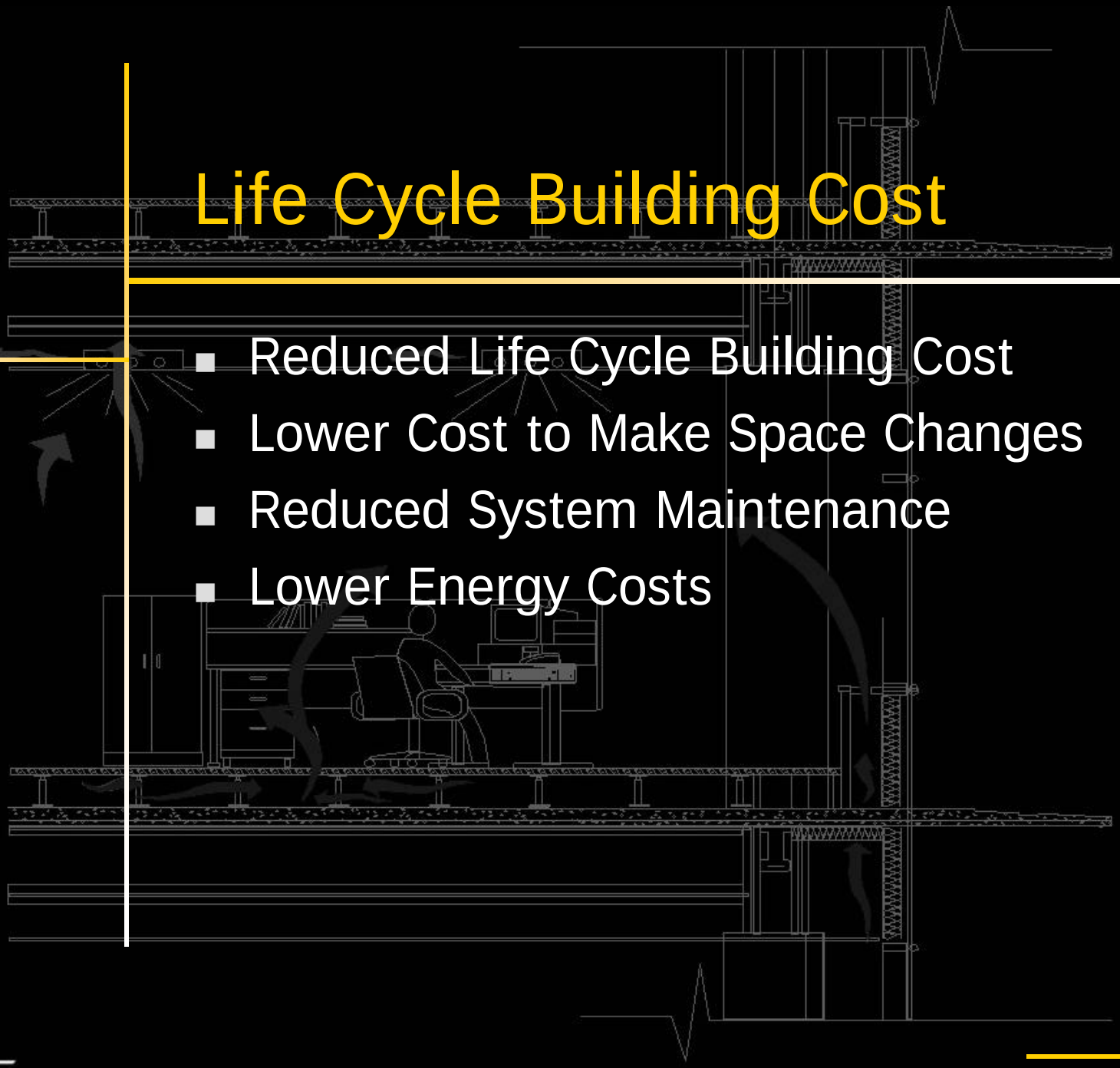
Cosentini
5 10 '96

Energy/Operating Costs

- Reduced Energy Usage
  - Only Cool where People/Equipment are Located
  - Only Condition Heat Load in Comfort Zone
  - Higher Supply Air Temperature
  - More Free Cooling Hours
  - Reduced Refrigeration Energy
  - Lower Overall Air Circulation than Standard
  - Lower Fan Energy
- Lower Maintenance Costs (Less Devices to Maintain)

Life Cycle Building Cost

- Reduced Life Cycle Building Cost
- Lower Cost to Make Space Changes
- Reduced System Maintenance
- Lower Energy Costs



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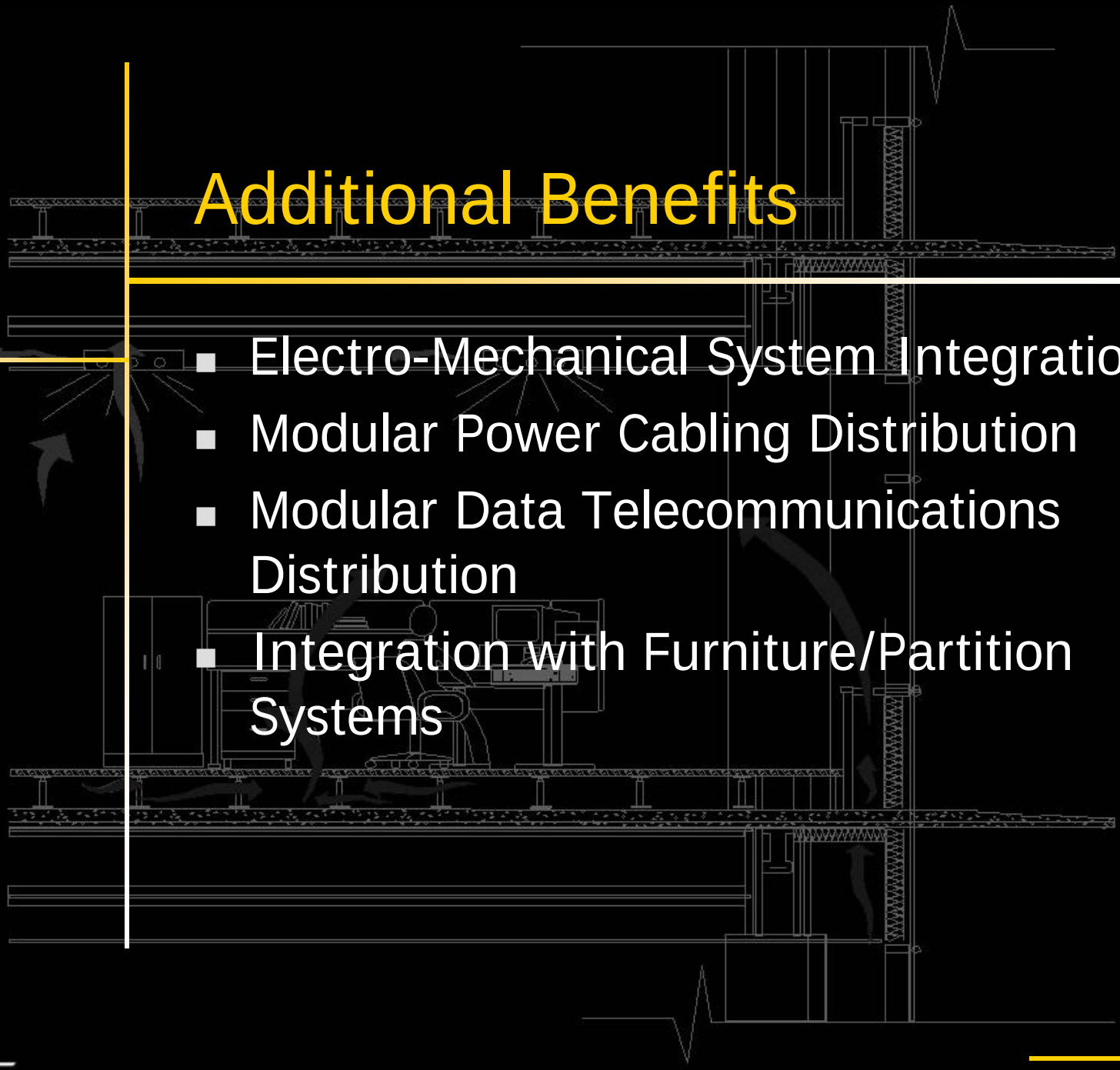
Additional Benefits

- Electro-Mechanical System Integration
- Modular Power Cabling Distribution
- Modular Data Telecommunications Distribution
- Integration with Furniture/Partition Systems



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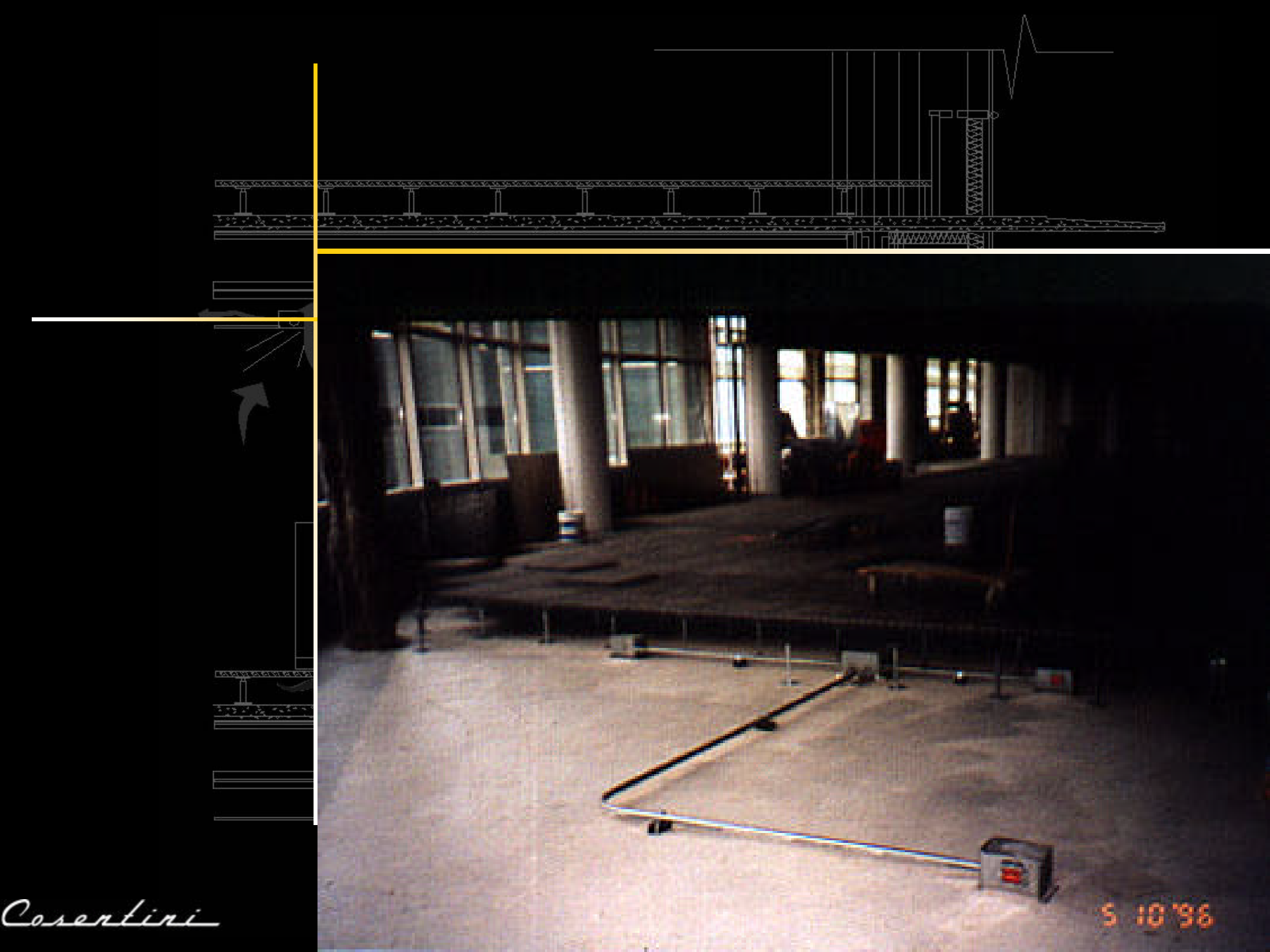
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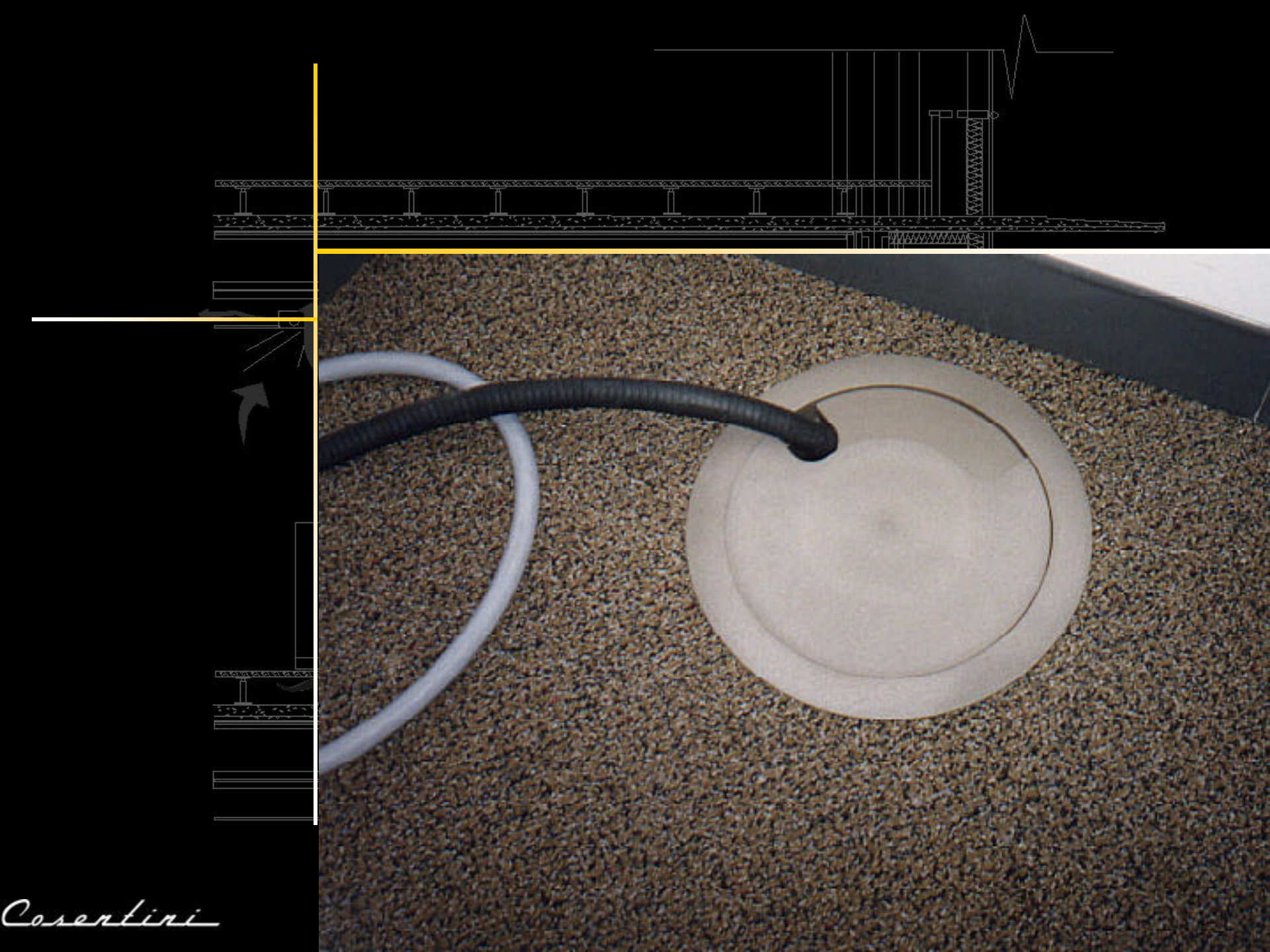

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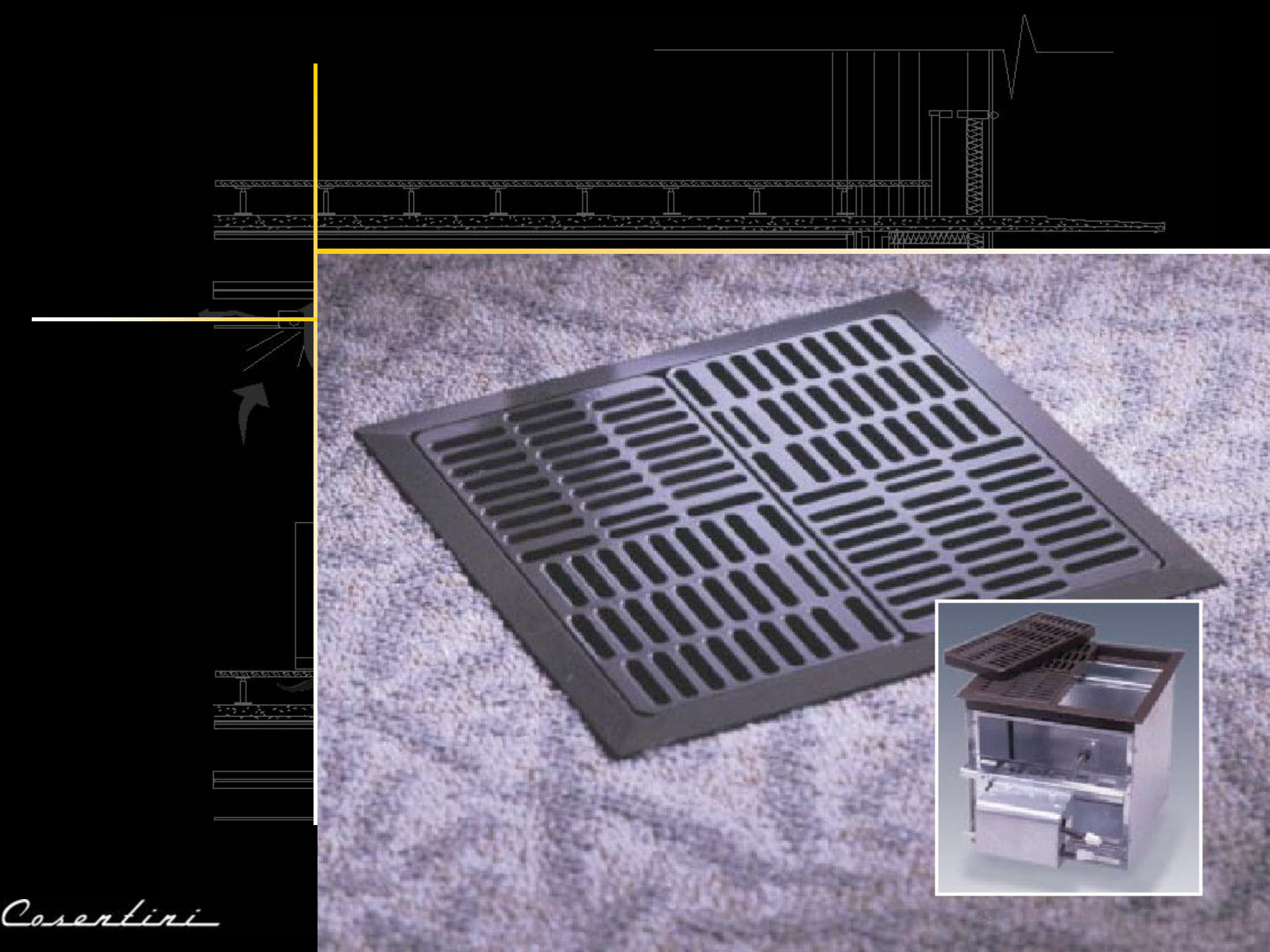

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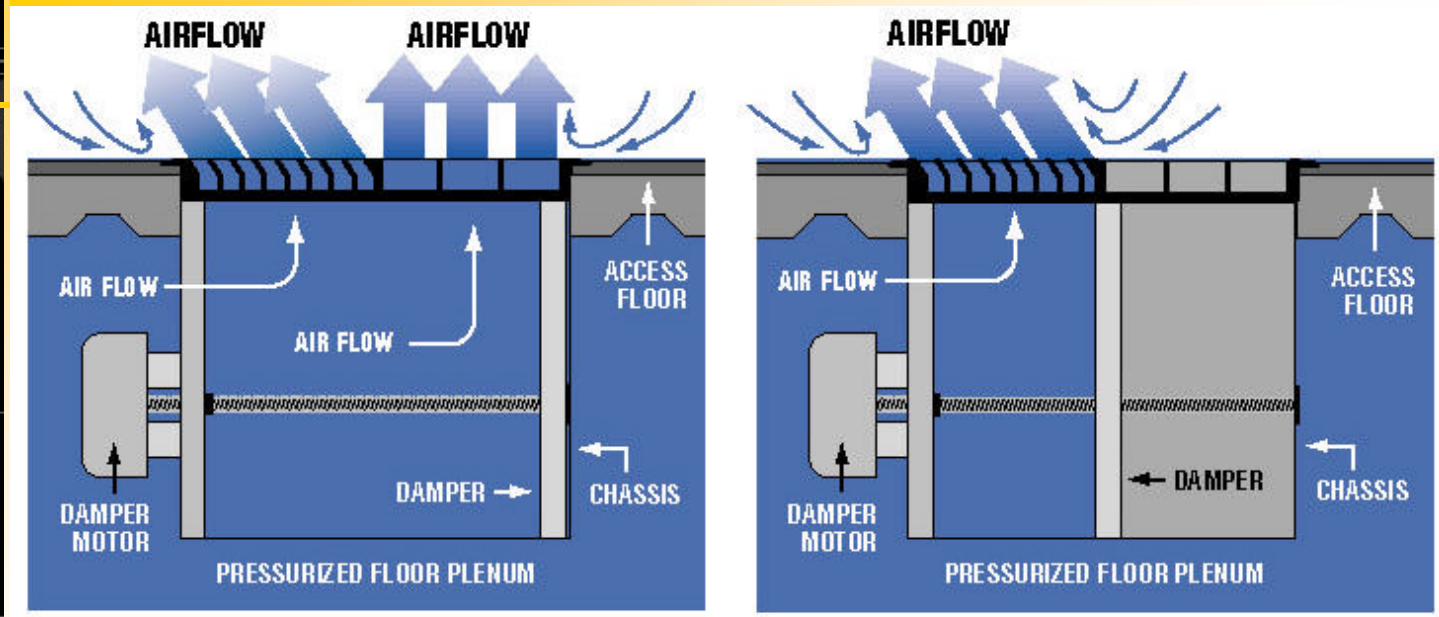
AIRFLOW
AIRFLOW
AIR FLOW
AIR FLOW
ACCESS FLOOR
DAMPER
CHASSIS
DAMPER MOTOR
PRESSURIZED FLOOR PLENUM
AIRFLOW
AIR FLOW
ACCESS FLOOR
DAMPER
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DAMPER MOTOR
PRESSURIZED FLOOR PLENUM

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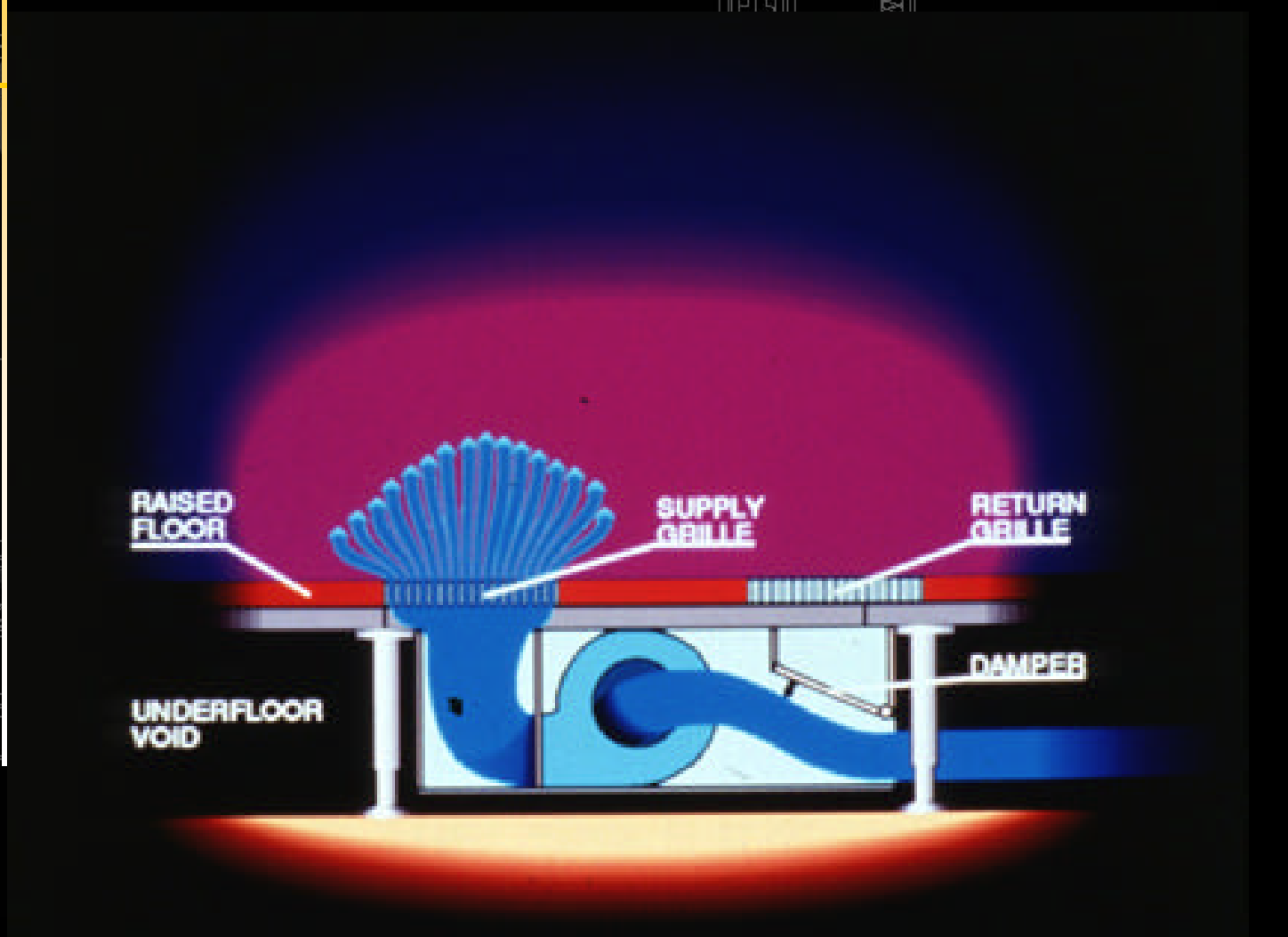
FTU Operation Diagram
Cooling/Heating Mode



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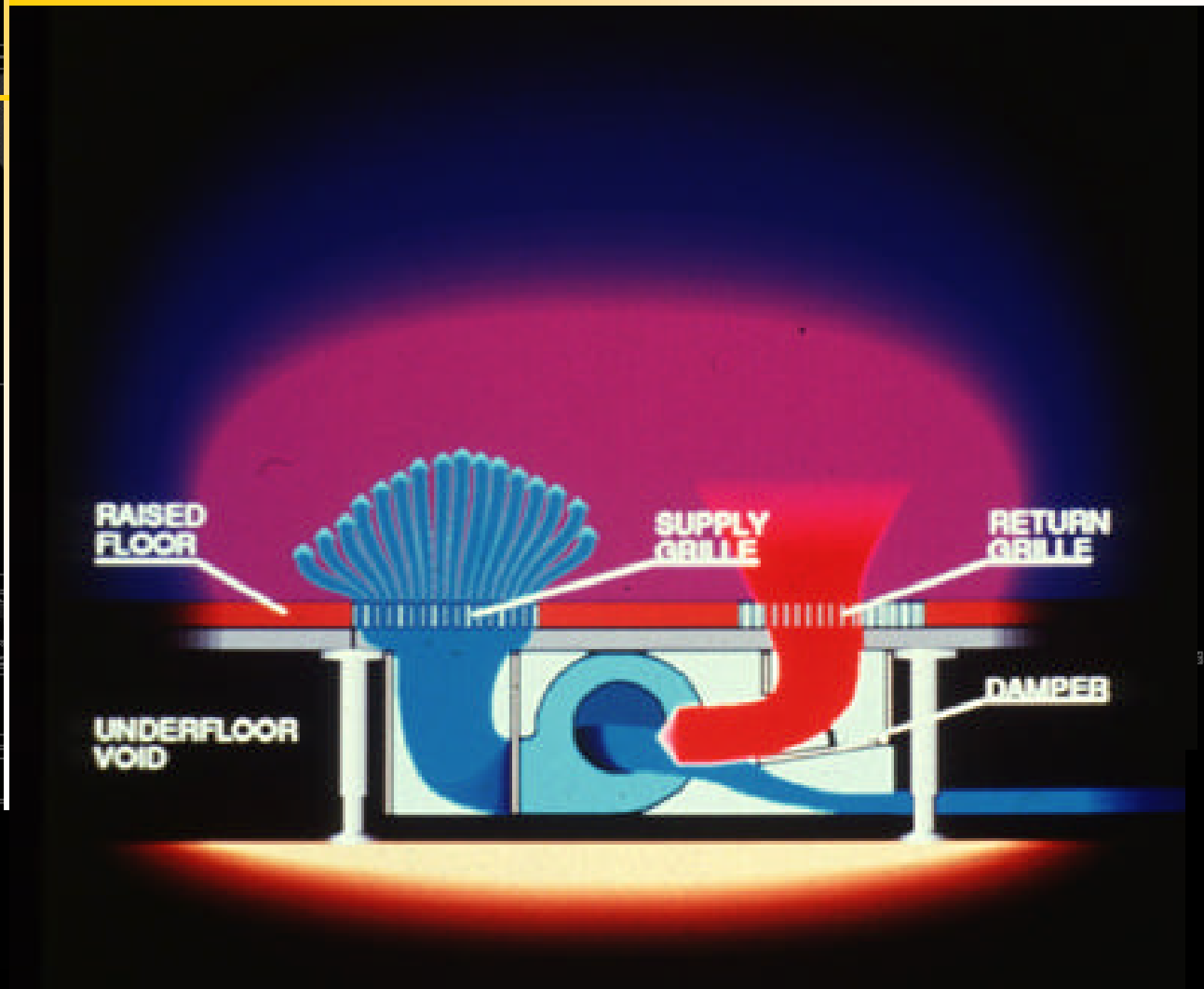
FTU Operation Diagram
Recirculation Mode



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Design Objectives

- Space requirements
  - Reduced Ceiling Plenum Requirements for Return Air, Sprinkler and Lighting
  - If No Ceiling, Need to Insure Heat and Contaminants are Above Occupied Zone
  - If No Ceiling and Private Office, Need to Insure Adequate Induction for Return Air
  - Raised Floor Height (10-12 Inch)

Perimeter Heating/Cooling Options

- Perimeter Heating/Cooling Strategies
  - Reduced Loads
    - Curtain Wall Efficiency (Shading Coeff., U-Value)
    - Type of Shading System
  - Common System
    - Use Interior Air with Booster/Static Heating,
      - Radiant, or Heating Coil
  - Independent System
    - All Air VAV
    - Air/Water

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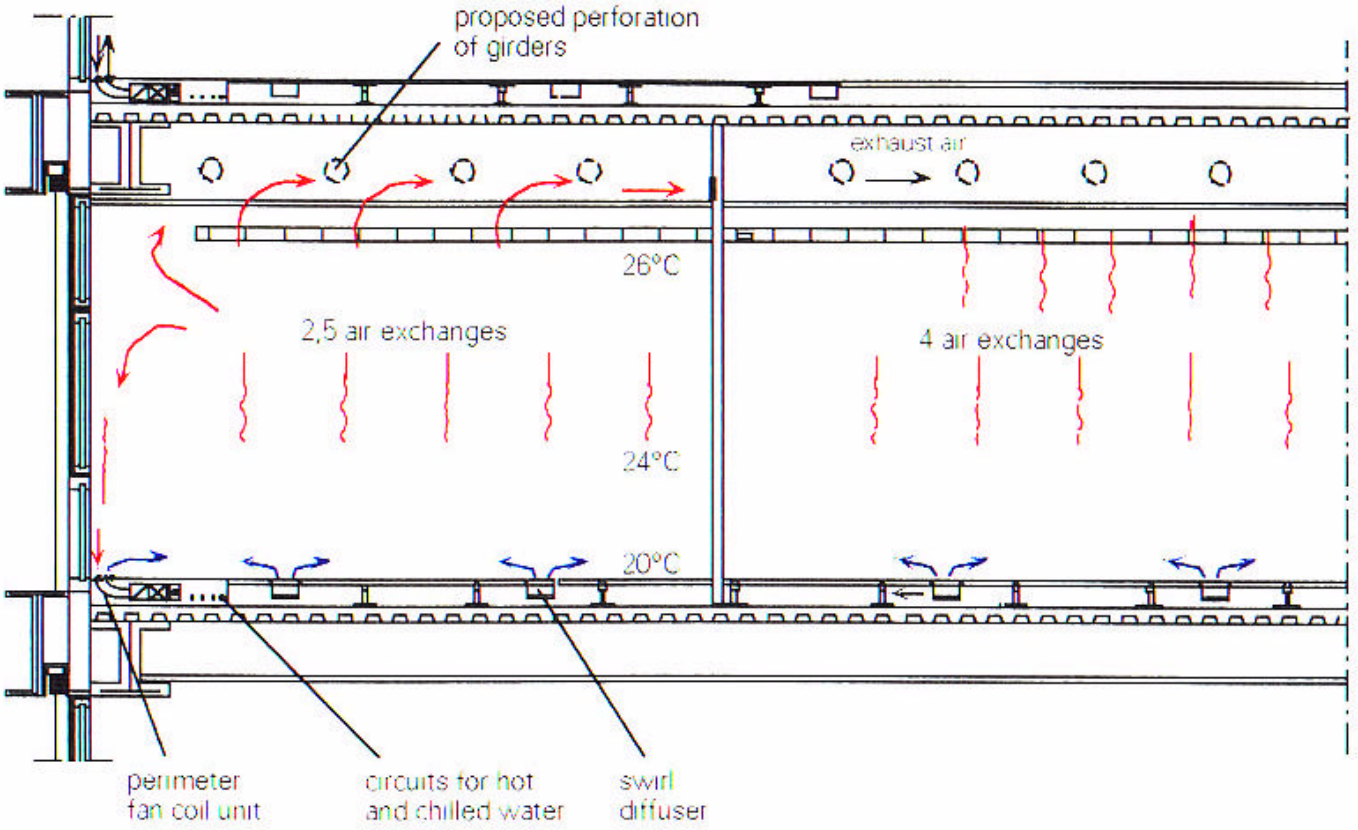
Summer:



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General Issues

- Overtime A/C Strategy/Under Floor Partitioning
- Multiple Tenants Per Floor
- Integrated Lighting/Sprinkler Configuration Allows for Flexible Partition Relocation
- “Exiting” Strategy - Speculative Office Use

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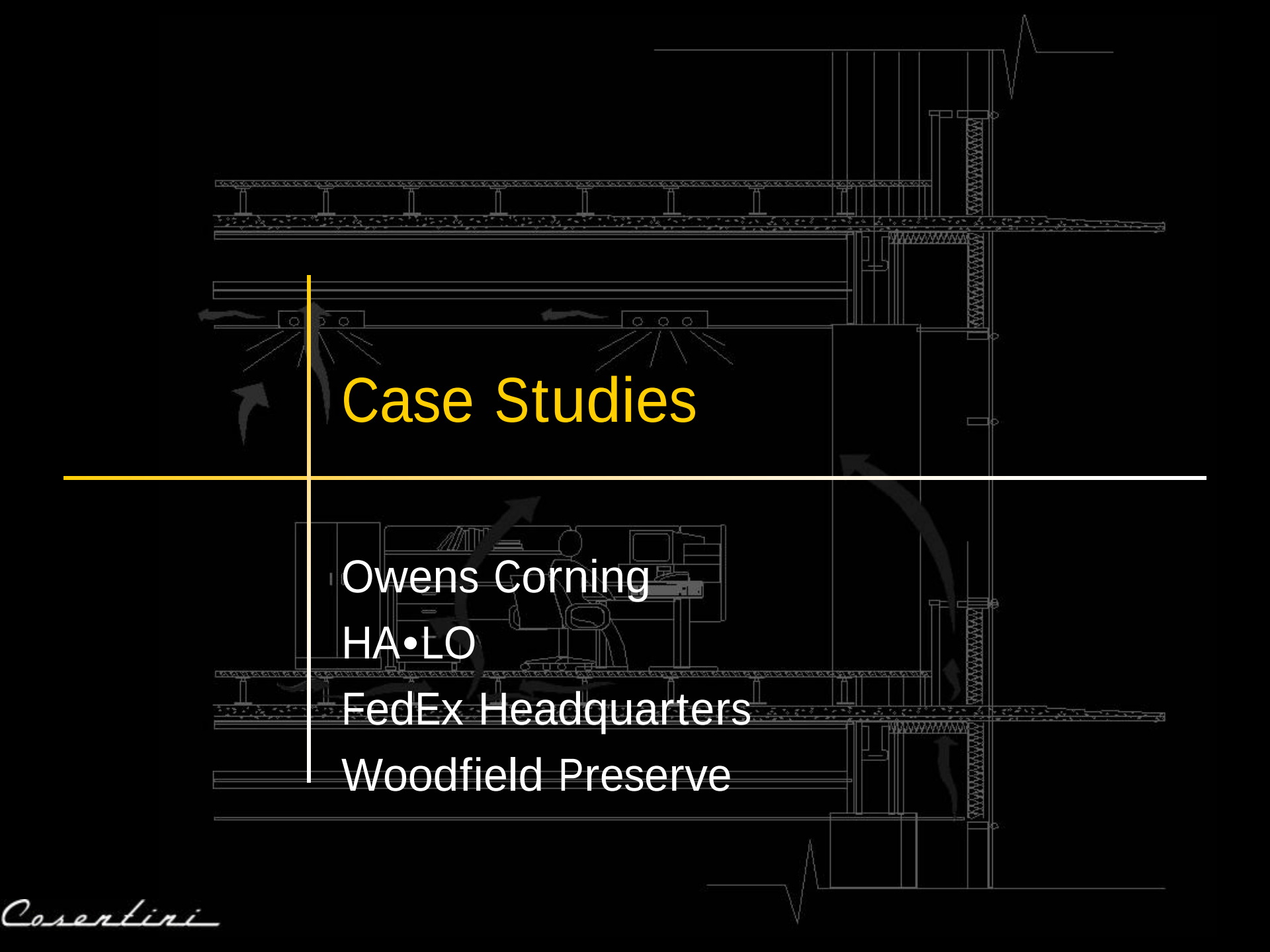

Case Studies

Owens Corning

HA•LO

FedEx Headquarters

Woodfield Preserve

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Owens Corning World Headquarters

1997 – Occupied

450,000 sq ft

Toledo, OH

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Owens Corning World Headquarters

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Owens Corning World Headquarters

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Owens Corning World Headquarters

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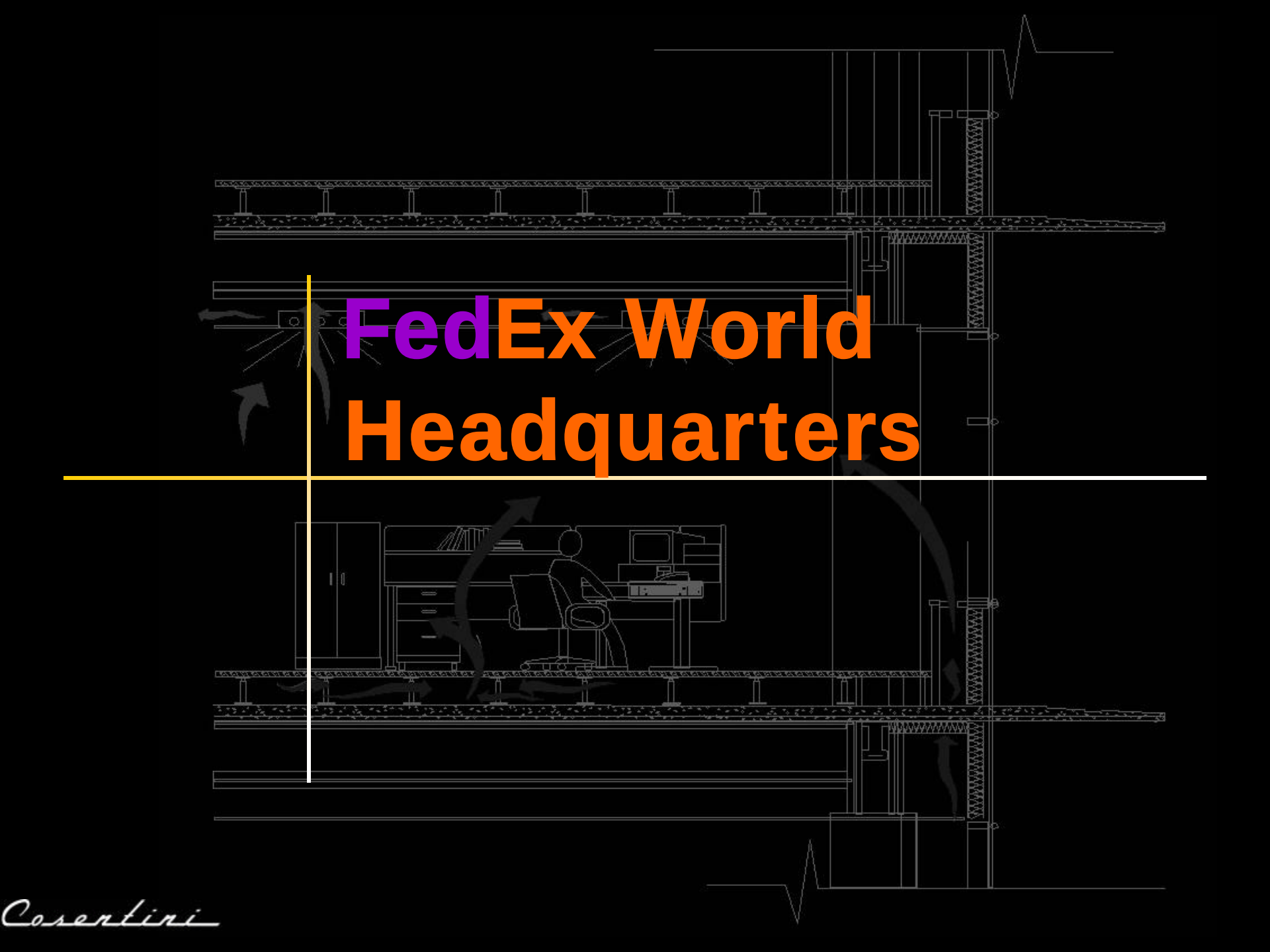
“The benefits - comfortable workspace, flexibility, energy savings, and quality environment - of underfloor distribution make the system choice a true success for Owens Corning.”

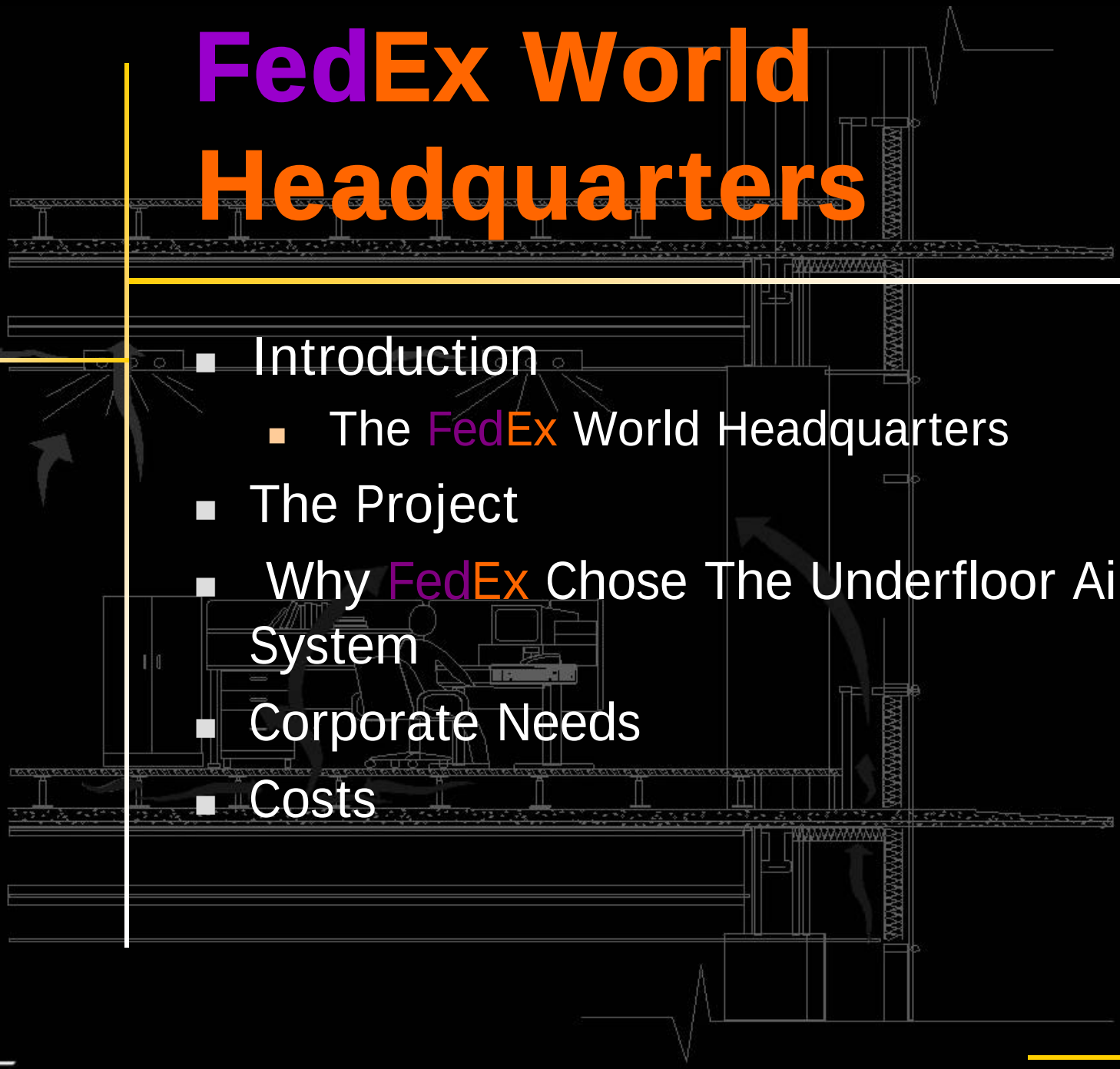
Jim Eckert, director of Corporate Facilities,

Owens Corning Headquarters


FedEx World
Headquarters
Cosentini

FedEx World Headquarters

- Introduction
  - The FedEx World Headquarters
- The Project
- Why FedEx Chose The Underfloor Air System
- Corporate Needs
- Costs



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FedEx World Headquarters

2001 – Occupied

1.1 Million sq ft

Memphis, TN

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FedEx World Headquarters

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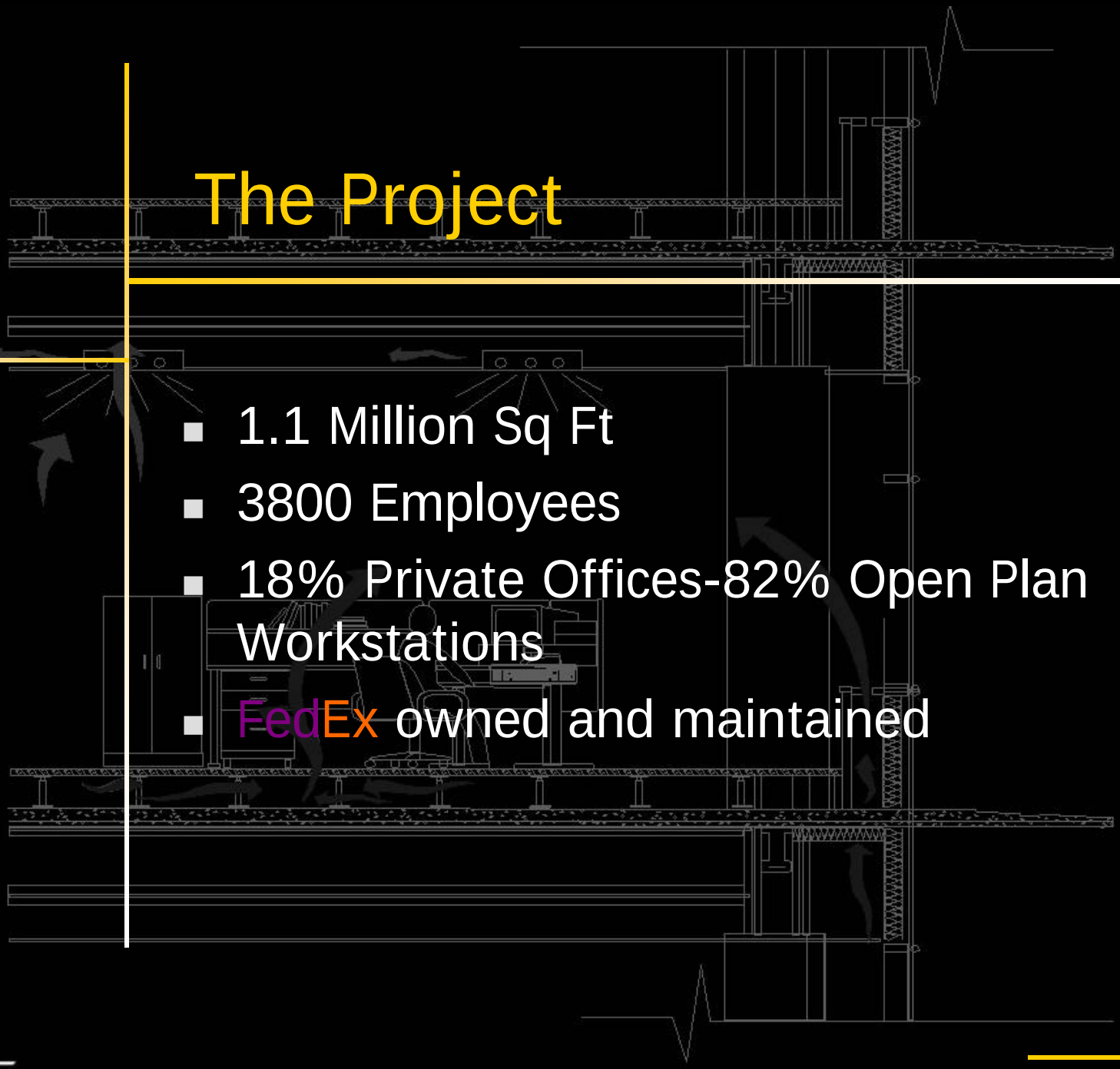
The Project



- 1.1 Million Sq Ft
- 3800 Employees
- 18% Private Offices-82% Open Plan Workstations
- FedEx owned and maintained

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FedEx World Headquarters

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FedEx World Headquarters

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FedEx World Headquarters

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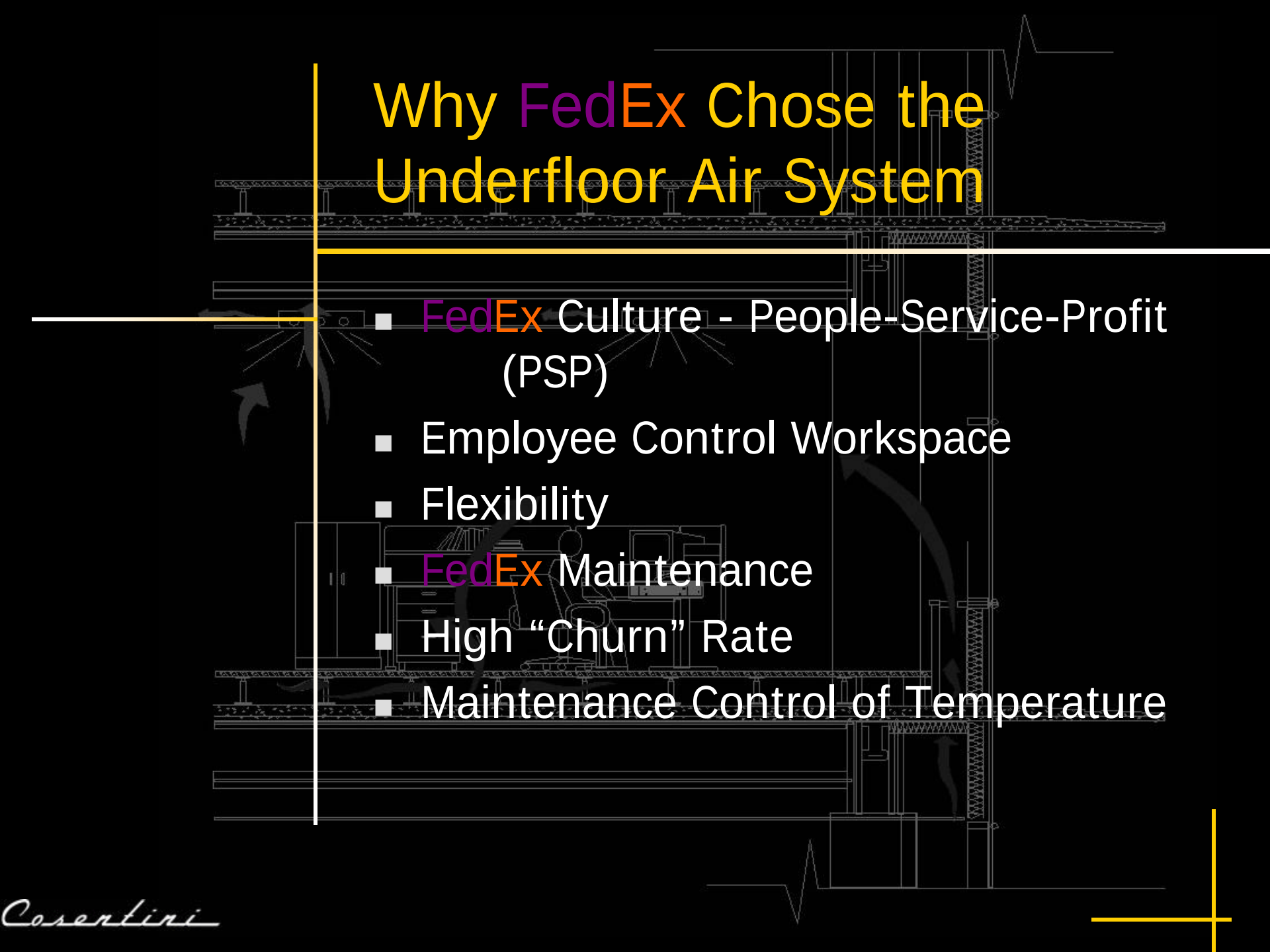
Why FedEx Chose the Underfloor Air System

- FedEx Culture - People-Service-Profit (PSP)
- Employee Control Workspace
- Flexibility
- FedEx Maintenance
- High “Churn” Rate
- Maintenance Control of Temperature



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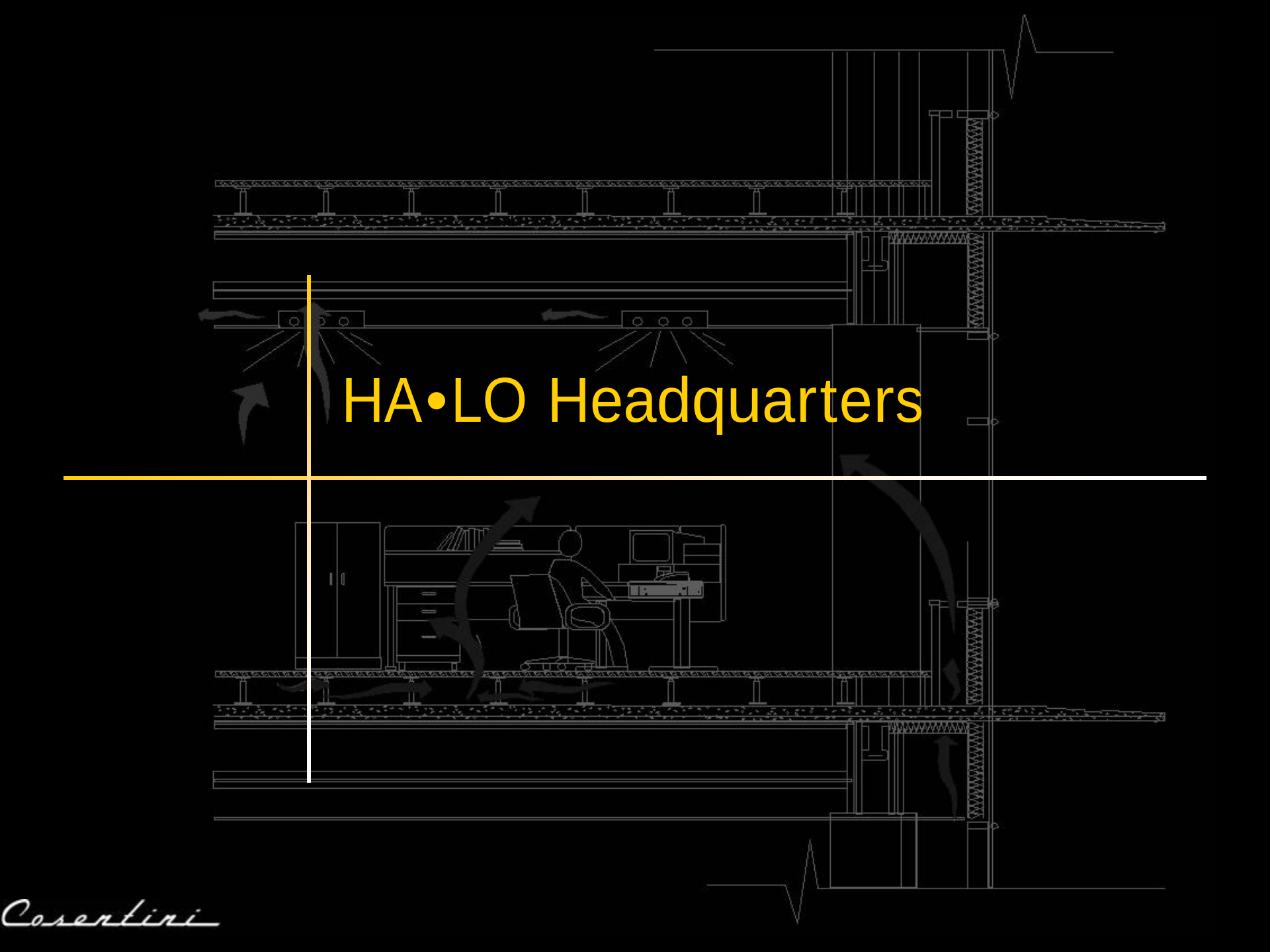
HA•LO Headquarters
Cosentini

HA•LO Headquarters

2001 – Occupied

235,000 sq ft

Niles, IL

Cosentini

HA•LO Headquarters

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HA•LO Headquarters

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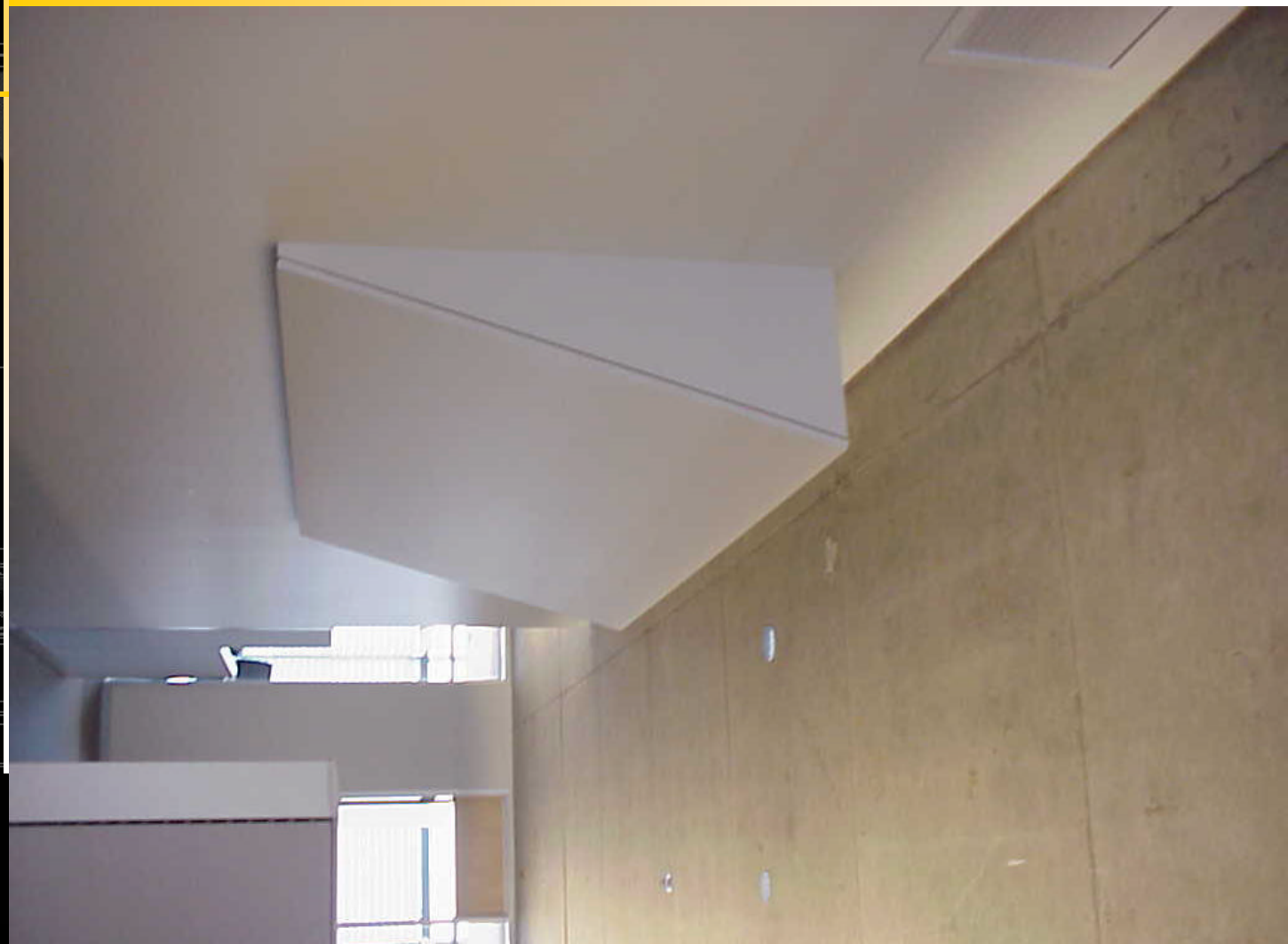
HA•LO Headquarters



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HA•LO Headquarters

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HA•LO Headquarters

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HA•LO Headquarters

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HA•LO Headquarters

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HA•LO Headquarters

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Woodfield Preserve Office Park

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Woodfield Preserve Office Park

2001 – Occupied

600,000 sq ft

Schaumberg, IL

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Woodfield Preserve Office Park

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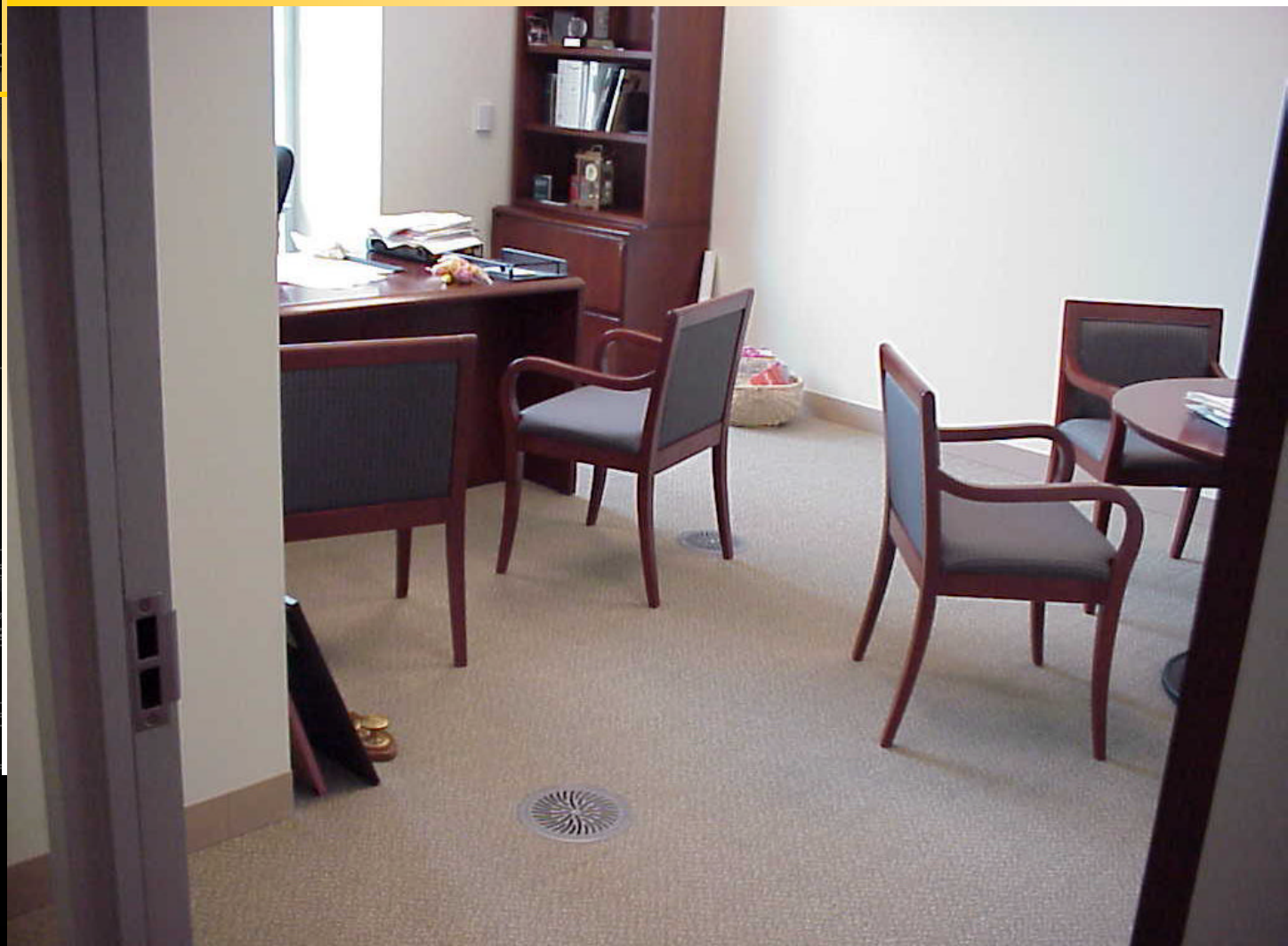
Woodfield Preserve Office Park



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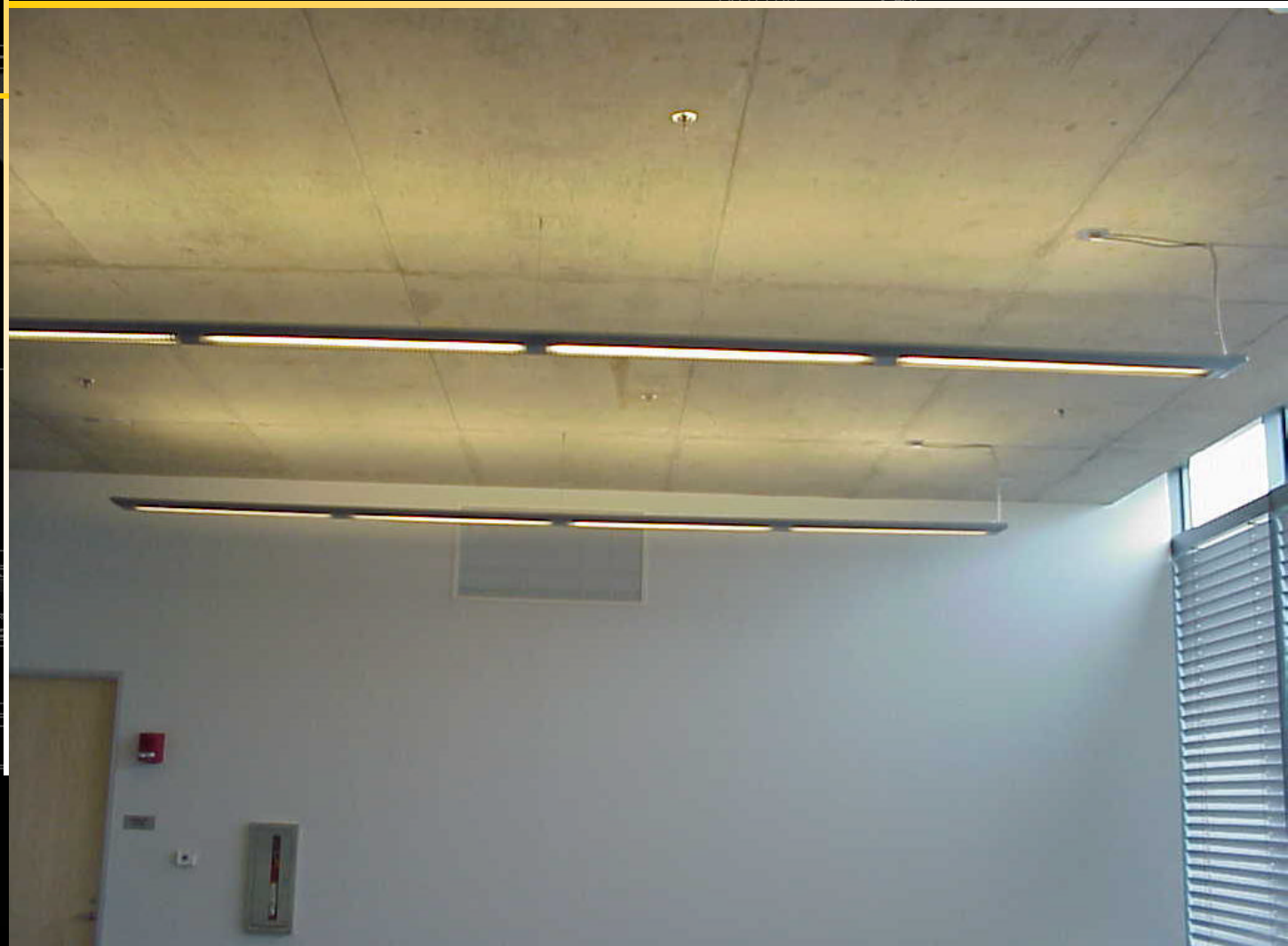
Woodfield Preserve Office Park



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Woodfield Preserve Office Park

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